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COMPARISON OF FOCUSED AND NEAR-FIELD IMAGING OF SPRAY ON FOAM INSULATION (SOFI) AT MILLIMETER WAVE FREQUENCIES

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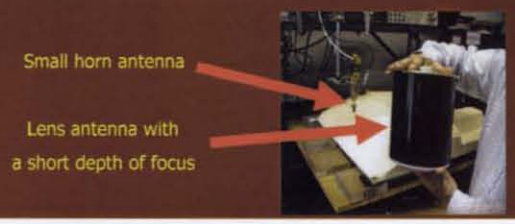
MOTIVATIO

- **The Space Shuttle Columbia's catastrophic accident was due to a piece of Spray on Foam Insulation (SOFI) that broke off from the external tank and damaged the leading edge of the orbiter's left wing.**
- **Millimeter wave focused and near-field imaging methods have been successfully used for inspecting of the SOFI samples.**
- **Comparison between these methods for the purpose of detection and evaluation of flaws in the SOFI is provided using examples of images of SOFI samples.**

NEAR-FIELD HORN AND FOCUSED LENS ANTENNAS



SOFI SAMPLES

(a) (b)

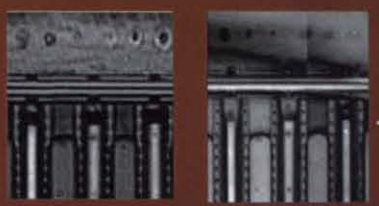
(a) Picture and (b) schematic of SOFI slab with 6-mm diameter voids of different heights backed by metal plate.

(a) (b)

The SOFI panel with embedded localized flaws: a) before and b) after SOFI application.

RESULTS

Images of the SOFI slab with holes obtained with (a) the small horn antenna at 70 GHz, (b) the small horn antenna at 100 GHz and (c) the lens antenna at 100 GHz.



73-GHz images of the SOFI panel obtained using (a) small horn antenna and (b) lens antenna with a long depth of focus.

(a) (b)

(a) (b) (c)

100-GHz images of the SOFI panel obtained using (a) small horn and (b) lens with a short depth of focus antenna focused at substrate and (c) at 2" above

SUMMARY

- Lens antennas are capable of focusing the incident beam and produce high spatial-resolution images of thick and thin SOFI. For relatively thin SOFI small horn antennas may be used for generating high quality images of the samples when located in the near-field region of a horn. The size and cost of the system with a small horn antenna can be significantly less than the size and cost of the system with a lens antenna.
- Images produced using the continuous wave reflectometer with a near-field horn antenna and a lens antenna with relatively long depth of focus provide through thickness information.

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